EVALUATING RISKS AND MITIGATING LOSSES:

New Opportunities and New Challenges

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Public/Private Collaboration in Development and Implementation of Risk Reduction Practices

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Natural hazards (earthquakes, severe storms, etc.) are inevitable extreme environments, but natural disasters are not inevitable. Disasters occur when people are directly exposed to extreme environments or when constructed facilities fail to shelter and support human activities. Disasters can be prevented by preparing constructed facilities to resist extreme environments, or when the environments are predictable, removing persons from the areas affected.

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There exist well-documented, nationally recognized practices for producing disaster resistant, constructed facilities, but substantial efforts are needed to implement them:

(1) awareness of decision makers and the general public that risk reduction is desirable and feasible;
(2) commitment of owners, designers, builders, financiers, policy makers, and regulators to the implementation of risk reduction practices;
(3) education and training of those responsible for implementation of risk reduction practices; and,
(4) effective implementation in design, construction, operation and maintenance.

There remain important knowledge needs to make disaster mitigation more cost effective:

(1) hazard characterization defining quantitatively the intensity of the environment, and, if possible, when and where it will occur;
(2) vulnerability assessment defining the direct and indirect consequences of the environment, at a given level of preparedness, as a basis for determining the benefits of additional mitigation activities;
(3) performance criteria and implementing standards and codes to define how to produce a built environment resistant to the natural hazard; and,
(4) engineered systems for design, construction, operation, maintenance, retrofit and emergency operations shown capable of meeting the performance criteria for disaster mitigation.

Insurance industry and government collaboration is vital to risk reduction. The government needs industry public-policy support, financial support and participation to fund and conduct the research and development needed to produce effective risk reduction practices. Insurance industry support and incentives are needed to assure that risk reduction practices are combined with risk sharing insurance programs. In turn, federal research and development and programmatic activities may make it feasible for the insurance industry to offer actuarially sound and cost effective insurance to the public at risk. The partnership the Insurance Institute for Property Loss Reduction is spearheading has high potential for reducing natural disaster losses for the public, industry and government.

National Science and Technology Council (NSTC)

The President has established the National Science and Technology Council, a cabinet-level group charged with setting federal tech-

nology policy, to coordinate and prioritize research and development and deployment strategies across a broad cross-section of public and private interests. It has established nine research and development committees, including the Committee on Civilian Industrial Technology (CCIT), to collaborate with the private sector in developing a comprehensive national technology policy. The NSTC provides an unprecedented opportunity for federal collaboration with the insurance and other industries for development and implementation of risk reduction practices.

The purpose of CCIT is to enhance the international competitiveness of United States industry through federal technology policies and programs. CCIT will provide a mechanism for coordinating national policy for this purpose across agency boundaries and will serve as a center for interagency exchange of information. CCIT will work closely with industrial leaders in determining research and development directions and setting priorities.

The Subcommittee on Construction and Building (C&B) of CCIT deals with federal technology policies and programs related to the industries that conduct research & development, and produce, operate, and maintain constructed facilities including buildings and infrastructure. This paper describes the planned cooperative activities of the federal agencies that participate in C&B as performers of research and development for building and construction or owners and users of constructed facilities, and the industry groups concerned as users, insurers, producers, or suppliers for constructed facilities.

Importance of the Construction Industry and Constructed Facilities

Construction is one of the nation's largest industries and a critical asset for enhancing the international competitiveness of United States industry. In 1993, new construction put in place amounted to $470 billion, 8% of the GDP, and provided employment for 6 million persons.

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The breakdown of new construction put in place in 1993 is: residential 44%; commercial, institutional and industrial 28%; public works 28%. (When renovation is included, construction probably amounts to about $800 billion annually, 13% of GDP, and 10 million jobs.) Constructed facilities shelter and support most human activities. Their quality affects the competitiveness of United States industry, the safety and quality of life of the people, and environmental quality. Moreover, the quality of construction strongly affects the wealth of the nation; over five-eighths of the nation's fixed reproducible wealth is invested in constructed facilities.

For United States industries to compete internationally, their technologies must be superior and their production facilities must be more cost effective than their competitors'.

Once built and operating, buildings consume annually $220 billion of energy (nearly half our total United States energy bill), of which $150 billion goes for electricity (80% of all electric revenues). Modernization could save $100 billion/year, with profitable payback times, and simultaneously improve comfort and thus make our work force more productive.

Construction is a giant, but desegregated, industry. Small enterprises predominate in construction. There usually is a unique team (owner, architect, structural engineer, general contractor, specialty contractors, etc.) for each construction project. Each participant may have several simultaneous projects. The team for each project usually never has worked together before, and will not again.

This desegregated structure allows the construction industry to adapt to large, rapid changes in the volume of construction work. This desegregated nature also gives construction great flexibility for innovation. A small organization can master a new technology or produce a new product, and convince an owner, designer or general contractor to try the innovation on a particular project, without having to break into a highly centralized, monolithic system. However, interfaces with other products or practices, liability concerns and regulations are barriers to innovation.

Construction includes the whole life of the project: initial planning and programming, design, manufacturing and site construction, occupancy and maintenance, condition assessment, retrofit and renovation or removal.

FIGURE 1 shows the life cycle of constructed facilities. This whole life viewpoint is necessary to give realistic attention to values and costs of constructed facilities. For instance, for an office building, the annual operating cost, including salaries of occupants, roughly equals the initial construction cost. The primary value comes from the productivity of the occupants, which depends on the capability of the building to meet user needs throughout its useful life.

The average level of new construction put in place over the last decade has been 8% of the Gross National Product (GNP) which is down from the 11.9% attained in 1966. In contrast, Japan's is about 16% of GNP. The effects of the low United States investment are seen in the condition of United States constructed civil infrastructure systems: according to the National Council on Public Works Improvement "the quality of America's infrastructure today is barely adequate to meet current requirements and insufficient to meet the demands of future economic growth." Effects also are seen on the productive capabilities of commerce and industry: according to David Aschauer "the decline in infras tructure investment can explain

half or more of the productivity decline in the United States."

Technical leadership is essential to the competitiveness of the United States construction industry. A survey of leading United States and foreign design and construction firms, published in Cost Engineering, obtained their views of international leadership in construction technologies. Nineteen areas of construction technology were considered; the United States was assessed by the respondents to lead in just four, be even in one and to trail in fourteen. Specific instances of foreign leadership were cited in innovative materials, tunneling, underground piping, robotics and earthquake engineering.

Comparisons of United States and foreign construction research, development and application efforts indicate the United States will fall further behind in technology and competitiveness unless actions are taken to change present trends. United States research support for construction technology is very limited compared to other nations and industries. A recent study by the Civil Engineering Research Foundation indicates that construction research and development is only 0.5% of construction value. Private sector research and development for construction focuses on product development from which research investments can be recouped in the marketplace. Most technology development work by design and construction firms is expensed to specific projects rather than reported as research and development, but these efforts are much smaller than the 1% of gross income reported by Japanese design-construction firms.

As with other giant, desegregated industries, such as agriculture and health, federal support is depended upon for nonproprietary research that provides the knowledge base for private innovation, environmental quality and public health and safety. In 1992 federal funding for health research amounted to $9.8 billion. In contrast, the Civil Engineering Research Foundation could identify about $1.3 billion for annual federal research for construction and civil infrastructure. United States technological leadership is unquestioned in health care. The health care industry has increased its share of gross national product from 7.4% in 1970 to 13.2% in 1991, while new construction has remained about 8% in recent years.

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The European Union and the European Free Trade Association permit free flow of construction products and services within Western Europe. This is the world's richest single market. It is comprised of 372 million persons. European standards and codes are used by the member countries for acceptance of products and services, and a European product approval system allows products made, tested and approved in one country to be used in all without further testing or approvals. In all of this effort there is little United States involvement or input. However, these actions may have profound impact on the United States. The European standards and product approval system may be a major barrier to United States exports of construction products and services, and may influence international standards for other markets to the detriment of United States interests. In order to gain access to the European market and other foreign markets, the United States will need comparable, nationally recognized practices for acceptance of construction products and services.

A barrier in international competitiveness is the cost of injuries and diseases among construction workers. Although the construction workforce represents about 6% of the nation's workforce, it is estimated that the construction industry pays for about one-third of the nation's workers' compensation. Workers' compensation insurance premiums range from 7% to 100% of payroll in the construction industry. A major cost is attributable to musculoskeletal injuries (sprains and strains). The means and methods of construction could be improved through ergonomics (redesign of the equipment and the job) to reduce this cost.

Mission of the Subcommittee on Construction and Building

The vision for the construction and building industries is:

- High quality constructed facilities support the competitiveness of United States industry and everyone's quality of life;
- United States industry leads in quality and economy in the global market for construction products and services;
- The construction industry and constructed facilities are energy efficient, environmentally benign, safe and healthful and sustainable in use of resources;
- Natural and manmade hazards do not cause disasters; and,
- Intelligent renewal, a process that cost-effectively uses limited economic, material, and human resources, is applied to rebuilding America.

The mission of the Subcommittee is to enhance the competitiveness of United States industry, public safety and environmental quality through research and development, in cooperation with United States industry, labor, and academia, for improvement of the life cycle performance of constructed facilities.

Goals in Construction and Building

The Subcommittee on Construction and Building has studied research priorities expressed by the construction industry in industry fora and in proposals for the Advanced Technology Program of the Department of Commerce. Two priority thrusts, better buildings, and health and safety of the construction workforce, have

been defined for further discussion with industry for focus of federal research and development and deployment efforts in the construction and building area.

Better Buildings
- 50% reduction in delivery time
- 50% reduction in operation and maintenance
- 30% increase in comfort and productivity
- 50% fewer occupant related illnesses and injuries
- 50% less waste and pollution; and,
- 50% more durability and flexibility

Health and Safety of Construction Workforce
- 50% reduction in job related illnesses and injuries

These goals will be achieved with improved housing affordability, and, where possible, with reduced other costs, both initial and life cycle.

The baseline for the above improvements will be today's business practices.

Major milestones for the program include:

Better Buildings
- Identify and evaluate current innovative building technologies, encourage their use and demonstration in currently planned building projects, and plan implementation of successful technologies (1995);
- Synthesize advanced technologies addressing the program goals from available knowledge, and define specific research objectives (1996);
- Demonstrate research based, advanced technology which realizes the program goals in demonstration projects ready for occupancy (1996-2001); and,
- Implement new standards making these technologies normal practice (2003);

Health and Safety of Construction Workers
- Identify construction practices of those companies with low injury records, incorporate and highlight such practices in currently planned building demonstration projects, and plan their general implementation (1995);
- Identify advanced state-of-the-art, safe, cost-effective construction practices, and define specific research objectives (1996);
- Demonstrate and evaluate safe, cost-effective construction practices (1996-1999); and,
- Implement new, research-based standards for construction practices (2000).

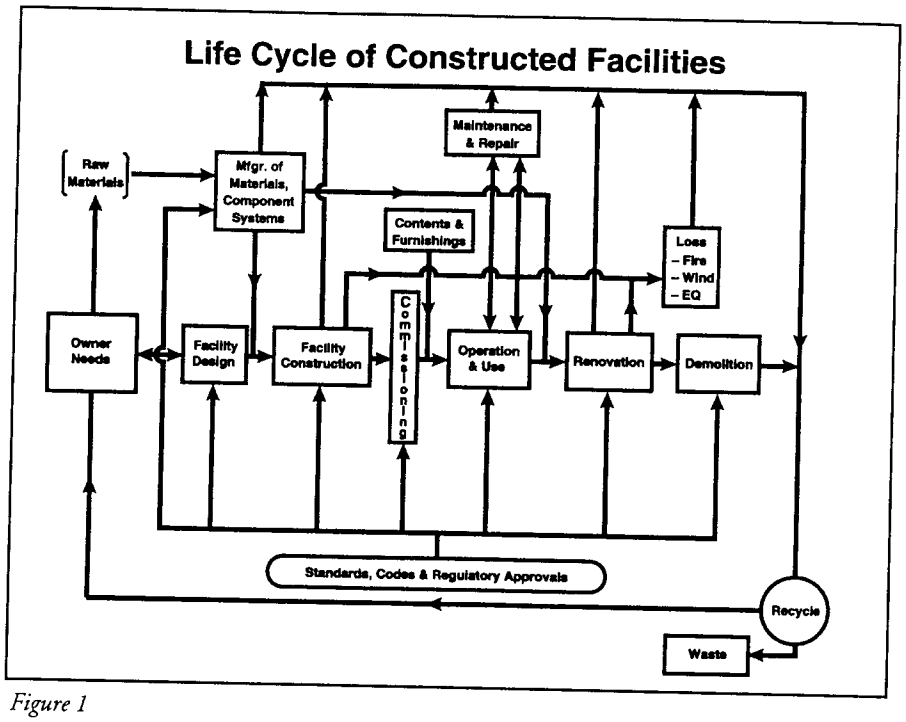

Figure 1

Four main mechanisms are planned for deployment of research development results:

(1) Develop streamlined decision making information and communication capabilities to support collaboration among the diverse participants in each construction project;

(2) National voluntary standards, used for agreements between buyers and sellers and cited in codes and regulations, are the major traditional mechanism for technology deployment in construction. In accord with OMB Circular A-119, "Federal Participation in the Development and Use of Voluntary Standards," federal agencies' staff will participate actively in voluntary standardization to move research & development results to practice. Mechanisms will be explored for increased involvement by both public and private sectors in the international standards setting process to facilitate the acceptance of United States construction products and practices in international markets;

(3) A large proportion of the nation's construction is federal or federally-assisted or regulated. In accord with the President's technology policy goals:

"federal agency purchasing policies designed to foster early markets for innovative products and services that contribute to national goals"

"investments in energy-efficient federal buildings to reduce wasteful energy expenses and encourage the adoption of innovative, energy efficient technology"

"review the nation's regulatory 'infrastructure' to ensure that unnecessary obstacles to technical innovation are removed and that priorities are attached to programs introduc-

ing technology to help reduce the cost of regulatory compliance"

"agencies should evaluate bids based on their ability to minimize life cycle cost rather than acquisition cost, including environmental, health and safety costs borne by the public"

"agencies should use performance-based contracting strategies that give contractors the design freedom and financial incentive to be innovative and efficient"

(4) Federal programs for constructed facilities management and renovation, construction and construction assistance, and regulation of construction will be mechanisms to introduce beneficial new technologies to practice and demonstrate their effectiveness for private sector applications.

(5) Technology deployment programs of the Advanced Research Projects Agency, the National Institute of Standards and Technology, the United States Army Corps of Engineers, the Department of Transportation, and the Department of Energy will be used to provide strategic support to United States industry. Linkages with academia will be developed through the National Science Foundation Engineering Research Centers and individual/group researchers.

"the quality of America's infrastructure today is barely adequate to meet current requirements and insufficient to meet the demands of future economic growth."

The program and goals for Construction and Building were reviewed with a focus group of construction industry leaders convened on April 5, 1994 by the Civil Engineering Research Foundation. The response of the focus group is described in the Construction Industry Whitepaper, "Innovation in the United States Construction Industry: An Essential Component for America's Economic Prosperity and Well-Being." The Whitepaper provides an industry perspective of methods and means that, if jointly supported and implemented by the public and private sector, promise to transform the construction sector into the high technology/high skill sector America requires.

- Construction industry leaders strongly endorse the ambitious goals recently established by the NSTC Subcommittee on Construction and Building; and,
- Industry leaders urge expanded dialogue and, most important, the immediate initiation of industry-federal government cooperative efforts to refine and implement actions.

Relevance for Risk Reduction Practices

Private-public sector collaborations to reduce disaster losses can be a key element of activities of the National Science and Technology Council to coordinate and define priorities for federal research, development and deployment programs, in cooperation with industry. The NSTC Subcommittee on Construction and Building looks forward to such collaborations with the insurance industry and other interested elements of the private sector.